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Development of Self-Assembled Monolayers of Lead-Free Double Halide Perovskites on Commercial Glass Substrates for Glycerol Conversion

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This research focuses on the surface functionalization of SiO_2 glass substrates with lead-free double halide perovskites of the type $Cs_2AgBiCl_6$, targeting their application in the photoconversion of glycerol—a byproduct of biodiesel production—into high value-added molecules. The main motivation lies in improving the recovery and reuse of semiconductor materials in photocatalytic processes. To this end, the glass substrates underwent a multi-step procedure including cleaning, surface activation using piranha solution (H_2SO_4/H_2O_2 in a 70:30 ratio), functionalization with molecular spacers, and subsequent anchoring of perovskite nanostructures [1]. The functionalization step was carried out using the drop-casting technique with 1 mmol L^{-1} solutions of tetradecylphosphonic acid (TPA) and 2-aminoethylphosphonic acid (2-AEP), followed by the T-BAG method (Tethering by Aggregation and Growth) to facilitate chemisorption of the nanostructures [3]. The $Cs_2AgBiCl_6$ nanocrystals were anchored onto the modified surfaces via drop-casting, leveraging hydrophobic and ionic interactions with the respective spacer molecules. Characterization by FTIR, XPS, AFM, and Raman spectroscopy confirmed successful nanometric deposition and uniform coverage of the perovskite layer on the glass substrates. Photocatalytic activity was assessed through Total Organic Carbon (TOC) analysis, GC-MS, and HPLC-MS. The results demonstrated that the $Cs_2AgBiCl_6$ perovskite enables partial oxidation of glycerol, leading to the formation of derivatized products and photoconversion into high-value compounds commonly used in the pharmaceutical and food industries [2].

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References

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